PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-303177
(43)Date of publication of application : 18.10.2002

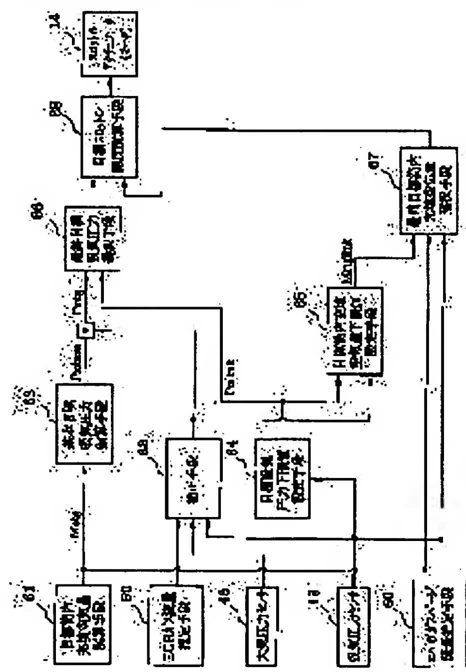
(51)Int.Cl. F02D 41/04
F02D 9/02
F02D 11/10
F02D 13/02
F02D 41/02
F02D 41/08
F02D 43/00
F02D 45/00

(21)Application number : 2001-105340
(22)Date of filing : 04.04.2001

(71)Applicant : DENSO CORP
(72)Inventor : MATSUMOTO HIRAKI
MABUCHI MAMORU

(54) ELECTRONIC THROTTLE CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To precisely control a throttle.
SOLUTION: A target cylinder filled air amount computing means 61 computes a target cylinder filed air amount in accordance with required torque as illustrated and basic target intake pressure computing means 62 computes a basic target intake pressure in accordance with the target cylinder filled air amount and an engine speed. Correcting means 63 corrects the basic target intake pressure depending on predetermined parameters as variation factors of an intake pressure to find a target intake pressure and target throttle opening computing means 68 computes a target throttle opening in accordance with the target intake pressure and the target cylinder filled air amount and controls a throttle actuator 14 in accordance with the target throttle opening. When the intake pressure detected by an intake pressure sensor 18 is a preset lower limit value or lower for the target intake pressure, the target intake pressure is set to be the lower limit value for the target intake pressure and the target cylinder filled air amount is set to be a lower limit value for the target cylinder filled air amount corresponding to the lower limit value for the target intake pressure.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]

CLAIMS

[Claim(s)]
[Claim 1] Have the throttle actuator which drives a throttle valve and the demand illustration torque which should be generated by an internal combustion engine's combustion based on the accelerator opening which the operator operated is calculated. In the electronic throttle control unit of the internal combustion engine which calculates target throttle opening based on this demand illustration torque etc., and controls said throttle actuator based on this target throttle opening A restoration air content operation means in a target cylinder to calculate the restoration air content in a target cylinder based on said demand illustration torque etc., A radical Motome label MAP operation means to calculate a radical Motome label MAP based on said restoration air content in a target cylinder and engine rotational speed, A target inhalation-of-air pressure correction means to amend said radical Motome label MAP according to the predetermined parameter leading to [of a MAP] fluctuation, and to ask for a target MAP, The electronic throttle control unit of the internal combustion engine characterized by having a target throttle opening operation means to calculate target throttle opening based on said target MAP and said restoration air content in a target cylinder.
[Claim 2] It has a restoration air content amendment means in a target cylinder to amend the restoration air content in a target cylinder calculated with said restoration air content operation means in a target cylinder according to the predetermined parameter leading to [of the restoration air content in a cylinder] fluctuation. Said target throttle opening operation means is the electronic throttle control unit of the internal combustion engine according to claim 1 characterized by calculating target throttle opening based on the restoration air content in a target cylinder amended with said restoration air content amendment means in a target cylinder, and said target MAP.
[Claim 3] Said target inhalation-of-air pressure correction means amends said radical Motome label MAP at least, using the amount of exhaust-gas ring currents, and/or an evaporated gas purge flow rate as a predetermined parameter leading to [of said MAP] fluctuation. Said restoration air content amendment means in a target cylinder is the electronic throttle control unit of the internal combustion engine according to claim 1 or 2 characterized by amending said restoration air content in a target cylinder at least, using an evaporated gas purge flow rate as a predetermined parameter leading to [of said restoration air content in a cylinder] fluctuation.
[Claim 4] It is the electronic throttle control unit of the internal combustion engine according to claim 1 to 3 characterized by calculating a radical Motome label MAP based on said restoration air content in a target cylinder, said engine rotational speed, and said valve timing in case it has the adjustable valve timing device which carries out adjustable [of the valve timing of an intake valve and/or an exhaust air bulb] and said radical Motome label MAP operation means calculates said radical Motome label MAP.
[Claim 5] The electronic throttle control unit of the internal combustion engine according to claim 1 to 4 characterized by to have a lower limit setting means set said target MAP as said target MAP lower limit, and set said restoration air content in a target cylinder as the restoration air content lower limit in a target cylinder corresponding to said target MAP lower limit when the MAP detected with a MAP detection means detect a MAP, and said MAP detection means becomes below a predetermined target MAP lower limit.
[Claim 6] The electronic throttle control unit of the internal combustion engine according to claim 1 to 5 characterized by having the phase-lead-compensation means which carries out phase lead compensation of said restoration air content in a target cylinder used with said target throttle opening operation means by the delay in consideration of delay until it appears as change of the restoration air content in a cylinder with an actual change of throttle opening.
[Claim 7] Said radical Motome label MAP operation means is the electronic throttle control unit of the internal combustion engine according to claim 1 to 6 characterized by calculating a radical Motome label

MAP, using target idle rotational speed as said engine rotational speed at the time of an idle.
[Claim 8] Said target throttle opening operation means is the electronic throttle control unit of the internal combustion engine according to claim 1 to 7 characterized by calculating target throttle opening using the reverse model of the inhalation-of-air system model which modeled the behavior of inhalation air until it appears as change of the restoration air content in a cylinder with an actual change of throttle opening.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electronic throttle control unit of the internal combustion engine which controlled the opening (throttle opening) of a throttle valve by throttle actuators (motor etc.).
[0002]
[Description of the Prior Art] In engine control of the electronics-control-ized conventional automobile, in order to realize good drivability of the responsibility suitable for accelerator actuation of an operator, the acceleration force (demand output torque) which an operator demands is judged from the accelerator opening which the operator operated, an engine speed, etc., and there are some which were made to perform the so-called torque demand control which controls the restoration air content in a cylinder (throttle opening), fuel oil consumption, ignition timing, etc. according to it. The conventional torque demand control system calculates the demand output torque according to an operator's accelerator control input and engine speed, it adds an engine loss torque to this demand output torque, searches for demand illustration torque (combustion pressure torque), calculates the restoration air content in a target cylinder (target intake air flow) according to this demand illustration torque, and he was trying to calculate target throttle opening according to this restoration air content in a target cylinder.
[0003] The demand output torque is the desired value (desired value) of the net torque taken out from a crankshaft here, demand illustration torque is the desired value (desired value) of the combustion pressure torque generated by engine combustion, and a loss torque is torque consumed with the friction loss inside an engine, etc. and the load of external auxiliary machinery. There is the following relation to each [these] torque.
Demand illustration torque = demand output-torque + loss torque [0004]
[Problem(s) to be Solved by the Invention] The engine of the engine of an automobile in recent years which carried the adjustable valve timing system, the exhaust-gas ring current system, the evaporated gas (evaporative gas) purge system, etc. for the purpose of a fuel consumption improvement, a high increase in power, and exhaust air emission reduction is increasing in number. since each of these systems become the factor which fluctuate the restoration air content in a cylinder , the operation precision of target throttle opening fell under the effect of adjustable valve timing , the amount of exhaust gas ring currents (EGR gas flow rate) , the amount of evaporated gas purges , etc. , and they had the fault that precise throttle control cannot perform , with the configuration which calculate target throttle opening like above-mentioned before based on the restoration air content in a target cylinder which set up according to demand illustration torque .
[0005] Moreover, for example, in the time of downward slope transit and moderation of high-speed transit, even if an engine speed is a high rotation region, the demand output torque becomes small. If the demand output torque becomes small, since a throttle valve will be closed and an inhalation air content will be extracted, if the demand output torque becomes small in a high rotation region, a MAP (intake manifold pressure) will decline greatly. By it, a MAP may decline to for example, 20kPa extent, consequently the engine oil in a cylinder may be sucked up in an inlet manifold, or the restoration air content in a cylinder may be insufficient, and fault, like a combustion condition becomes unstable may occur.
[0006] This invention is made in consideration of these situations, the 1st purpose is offering the electronic throttle control unit of the internal combustion engine which can perform precise throttle control, and the 2nd purpose is offering the electronic throttle control unit of the internal combustion engine which can prevent beforehand faults, such as sucking of the engine oil by the extreme fall of a MAP.

[0007]
[Means for Solving the Problem] In order to attain the 1st purpose of the above, according to the electronic throttle control unit of the internal combustion engine of claim 1 of this invention, the restoration air content operation means in a target cylinder calculates the restoration air content in a target cylinder (target intake air flow) based on demand illustration torque etc., and a radical Motome label MAP operation means calculates a radical Motome label MAP based on this restoration air content in a target cylinder, and engine rotational speed. And a target inhalation-of-air pressure correction means amends a radical Motome label MAP according to the predetermined parameter leading to [of a MAP] fluctuation, and it asks for a target MAP, and a target throttle opening operation means calculates target throttle opening based on this target MAP and said restoration air content in a target cylinder, and controls a throttle actuator based on this target throttle opening.
[0008] With this configuration, since target throttle opening is calculated based on a target MAP and the restoration air content in a target cylinder, as compared with the case where target throttle opening is calculated, the operation precision of target throttle opening can be improved only from the restoration air content in a target cylinder like before. And since the radical Motome label MAP calculated based on the restoration air content in a target cylinder and engine rotational speed is amended according to the predetermined parameter leading to [of a MAP] fluctuation and it asked for the target MAP, the target throttle opening which eliminated effect with the parameter concerned can calculate, and the precise throttle control which fulfills the restoration air content in a target cylinder is attained also under the service condition to which a MAP changes with the parameter concerned.
[0009] Furthermore, according to the predetermined parameter leading to [of the restoration air content in a cylinder] fluctuation, the restoration air content amendment means in a target cylinder amends the restoration air content in a target cylinder calculated based on demand illustration torque etc. like claim 2, and you may make it calculate target throttle opening based on the restoration air content in a target cylinder and target MAP after amendment. If it does in this way, according to the predetermined parameter leading to fluctuation, it can amend about the restoration air content in a target cylinder as well as a target MAP, and the control precision of the restoration air content in a cylinder can be improved further.
[0010] In this case, as a parameter leading to [of a MAP or the restoration air content in a cylinder] fluctuation, there are the amount of exhaust-gas ring currents (EGR gas flow rate), an evaporated gas purge flow rate, atmospheric pressure, etc., for example. Although an EGR gas flow rate and an evaporated gas purge flow rate are disturbance-air contents which do not pass a throttle valve since EGR gas and evaporated gas are introduced into the inlet manifold of the downstream of a throttle valve, as for EGR gas, the inert gas component after combustion mostly comes out, and, for a certain reason, the effect on the torque by the EGR gas flow rate is extent which does not interfere even if it ignores. Therefore, even if it takes an EGR gas flow rate into consideration as a fluctuation factor of only a MAP, it does not interfere. On the other hand, evaporated gas is new mind (air before combustion) that HC concentration introduced into an inlet manifold from the canister which adsorbs HC component which evaporates from a fuel tank is high, and serves as inhalation new mind which is not detected by the inhalation air content sensor (intake air flow sensor) installed in the upstream of a throttle valve. Therefore, as for an evaporated gas purge flow rate, it is desirable to take into consideration as a fluctuation factor of both a MAP and the restoration air content in a cylinder.
[0011] Then, it is good to amend a radical Motome label MAP at least like claim 3, using an EGR gas flow rate and/or an evaporated gas purge flow rate as a predetermined parameter leading to [of a MAP] fluctuation, and to amend the restoration air content in a target cylinder at least, using an evaporated gas purge flow rate as a predetermined parameter leading to [of the restoration air content in a cylinder] fluctuation. If it does in this way, main fluctuation factors can be taken out out of various fluctuation factors over a MAP and the restoration air content in a cylinder, and a radical Motome label MAP and the restoration air content in a target cylinder can be amended with a sufficient precision.
[0012] By the way, it sets to the internal combustion engine having the adjustable valve timing device which carries out adjustable [of the valve timing of an intake valve and/or an exhaust air bulb]. Although you may make it valve timing amend a radical Motome label MAP after the operation of a radical Motome label MAP since a MAP changes with valve timing Since it changes with engine rotational speed or the restoration air contents in a cylinder, when valve timing amends a radical Motome label MAP, as for the effect of the valve timing exerted on a MAP, it is desirable to also take into consideration the relation of valve timing, engine rotational speed, and the restoration air content in a cylinder.
[0013] As mentioned above, since they use in case they calculate a radical Motome label MAP, in case

engine rotational speed and the restoration air content in a cylinder calculate a radical Motome label MAP, it is good [air content] in this invention like claim 4 to calculate a radical Motome label MAP based on the restoration air content in a target cylinder, engine rotational speed, and valve timing. If it does in this way, while being able to ask for the radical Motome label MAP which wove in the effect of valve timing and being able to eliminate the effect of valve timing, data processing for weaving the effect of valve timing into a target MAP also becomes easy.
[0014] Moreover, in order to attain the 2nd purpose mentioned above, when the MAP (intake manifold pressure) detected with the MAP detection means becomes below a predetermined target MAP lower limit, it is good to set a target MAP as a target MAP lower limit, and to set the restoration air content in a target cylinder as the restoration air content lower limit in a target cylinder corresponding to a target MAP lower limit with a lower limit setting means. If it does in this way, fault, like the extreme fall of a MAP is avoidable also under a service condition to which demand illustration torque becomes small at the time of high engine speeds, the engine oil in a cylinder is sucked up in an inlet manifold, or the restoration air content in a cylinder is insufficient, and a combustion condition becomes unstable can be beforehand prevented like at the time of downward slope transit and moderation of high-speed transit, for example.
[0015] Moreover, in case target throttle opening is calculated based on a target MAP and the restoration air content in a target cylinder, it is good to be made to carry out phase lead compensation of the restoration air content in a target cylinder with a phase-lead-compensation means by the delay like claim 6 in consideration of delay until it appears as change of the restoration air content in a cylinder with an actual change (change of a throttle passage air content) of throttle opening. If it does in this way, the effect of the lag unit of an inhalation-of-air system can be eliminated, and the control precision of the restoration air content in a cylinder can be improved.
[0016] Moreover, you may make it calculate a radical Motome label MAP like claim 7 at the time of an idle, using target idle rotational speed as an engine rotational speed. Since a radical Motome label MAP will be set up at the time of an idle so that engine rotational speed may be completed as target idle rotational speed if it does in this way, idle rotational stability can be improved.
[0017] Moreover, you may make it calculate target throttle opening using the reverse model of the inhalation-of-air system model which modeled the behavior of inhalation air until it appears as change of the restoration air content in a cylinder with an actual change of throttle opening like claim 8. That is, since the reverse model of an inhalation-of-air system model turns into a model which considers a target MAP and the restoration air content in a target cylinder as an input, and considers throttle opening as an output, based on a target MAP and the restoration air content in a target cylinder, control of the precise restoration air content in a cylinder is realizable by using the reverse model of an inhalation-of-air system model.
[0018]
[Embodiment of the Invention] Hereafter, 1 operation gestalt which applied this invention to the injection type engine in a cylinder is explained based on a drawing.
[0019] First, based on drawing 1 , the outline configuration of the whole engine control system is explained. An air cleaner (not shown) is formed in the maximum upstream section of the inlet pipe 12 of the injection type engine 11 in a cylinder which is an injection type internal combustion engine in a cylinder, and the air flow meter 13 which detects an inhalation air content is formed in the downstream of this air cleaner at it. The throttle valve 15 by which opening accommodation is carried out by the motors 14, such as a DC motor, is formed in the downstream of this air flow meter 13. The opening (throttle opening) of a throttle valve 15 is controlled by this motor 14 driving based on the output signal from the engine electronic control circuit (it being written as "ECU" below) 16, and the inhalation air content of each gas column HE is adjusted by that throttle opening by it.
[0020] A surge tank 17 is formed in the downstream of this throttle valve 15, and the MAP sensor 18 (MAP detection means) which detects a MAP to this surge tank 17 is attached. The inlet manifold 19 which introduces air into each gas column of an engine 11 is connected to a surge tank 17, and the swirl control valve 20 for controlling the swirl style in the cylinder of an engine 11 is formed in the inlet manifold 19 of each gas column. An ignition plug 25 is attached in the cylinder head of an engine 11 for every gas column, and it is lit by the spark discharge of each point fire plug 25 at the gaseous mixture in a cylinder.
[0021] The fuel injection valve 21 which injects a fuel directly into a cylinder is attached in the upper part of each gas column of an engine 11, the fuel in a fuel tank 22 is pressurized by high pressure with a fuel pump 23, the fuel injection valve 21 of each gas column is supplied, and the pressure (fuel pressure) of the fuel is detected by the fuel-pressure sensor 24. Moreover, the evaporated gas (evaporative gas) which occurred in the fuel tank 22 is adsorbed in a canister 43 through the EBAPO piping 42. It is that the purge piping 45

which has the purge control valve 44 connects with the surge tank 17 of an inlet pipe 12, and this canister 43 controls the opening of the purge control valve 43 according to an engine operation condition, and the flow rate (evaporated gas purge flow rate) of the evaporated gas purged in a surge tank 17 from a canister 43 is controlled.

[0022] The intake valve 26 and the exhaust air bulb 27 of an engine 11 are driven with cam shafts 28 and 29, respectively, and the adjustable valve timing device 30 (VVT) of the hydraulic-drive type which carries out adjustable [of the closing motion timing of an intake valve 26] according to an engine operation condition is formed in the cam shaft 28 of an inspired air flow path. The oil pressure which drives this adjustable valve timing device 30 is controlled by the hydraulic control valve 31. The rotation drive of the crankshaft 33 is carried out by the reciprocating motion of the piston 32 of each gas column of an engine 11, and auxiliary machinery 34 and a cars (compressor [of an air-conditioner], AC-dynamo, torque-converter, pump of power steering, etc.) drive system drive by the running torque of this crankshaft 33. The coolant temperature sensor 35 which detects cooling water temperature is attached in the cylinder block of an engine 11.

[0023] On the other hand, the catalysts 37, such as a three way component catalyst which purifies exhaust gas, are formed in the exhaust pipe 36 of an engine 11, and the air-fuel ratio sensor 38 (or oxygen sensor) which detects the air-fuel ratio (or rich/Lean) of exhaust gas to the upstream of this catalyst 37 is formed in it. Between the upstream of the air-fuel ratio sensor 38 of the exhaust pipes 36, and a surge tank 17, the EGR piping 39 for making a part of exhaust gas return to an inspired air flow path is connected, and EGR valve 40 is formed while being this EGR piping 39. During engine operation, it is controlling the opening of EGR valve 40 according to an engine operation condition, and the amount of exhaust-gas ring currents (EGR gas flow rate) is controlled.

[0024] ECU16 which controls an engine operation condition is constituted considering a microcomputer as a subject, is performing the torque demand control program memorized by the ROM (storage), and realizes each function of the demand illustration torque operation means 51 shown in drawing 2 , the combustion mode means for switching 52, the homogeneity combustion mode control means 53, and the stratification combustion mode control means 54. Hereafter, each [these] function is explained concretely.

[0025] The demand illustration torque operation means 51 computes demand illustration torque based on the output of the accelerator sensor 41 which detects the opening (accelerator opening) of an accelerator pedal etc. Here, demand illustration torque is the desired value (desired value) of illustration torque, and illustration torque is the torque generated by combustion of an engine 11, i.e., torque including the internal loss torque and external load torque (load of auxiliary machinery 34) of an engine 11. Therefore, the torque which deducted an internal loss torque and external load torque from illustration torque turns into output torque (net torque) taken out from a crankshaft 33, and a car drive system drives it with this output torque.

[0026] The demand illustration torque operation means 51 computes the demand output torque based on the output (accelerator opening) of the accelerator sensor 41, engine-speed Ne, the vehicle speed, etc., adds various kinds of loss torques later mentioned to this demand output torque, further, amends a part for the torque increase and decrease by idle speed control (ISC control) from this torque, and searches for demand illustration torque. Here, the internal loss torques added to the demand output torque are machine friction loss and pumping loss, machine friction loss is computed by a map or the formula based on an engine speed Ne and the cooling water temperature THW, and pumping loss is computed by a map or the formula based on an engine speed Ne and an intake pressure Pm. Moreover, the external load torque added to the demand output torque is the loads (compressor [of an air-conditioner], AC-dynamo, pump of power steering, etc.) torque of the auxiliary machinery 34 driven under the power of an engine 11, and is set up according to an air-conditioner signal, the load current of an AC dynamo, etc. The amendment torque (a part for torque increase and decrease) by ISC control is computed by a map or the formula based on the target idle rotational speed Netarget and the current engine speed Ne.

[0027] In addition, in case demand illustration torque is calculated, the loss and loads other than the internal loss shown in drawing 2 or an external load may be added, or some of loss and loads are disregarded on the contrary from the internal loss shown in drawing 2 , or an external load, and you may make it simplify an operation.

[0028] On the other hand, the combustion mode means for switching 52 chooses the homogeneity combustion mode control means 53 or the stratification combustion mode control means 54 from a map etc. according to an engine speed Ne and demand illustration torque, and switches combustion mode. For example, in a low rotation field and a low torque field, the stratification combustion mode control means 54 is chosen, and it is operated in stratification combustion mode. a fuel little at the time of this stratification

combustion mode operation -- a compression stroke -- the inside of a cylinder -- injecting directly -- stratification -- fuel consumption is raised by forming gaseous mixture and carrying out stratification combustion. Moreover, in inside and a quantity rotation field, and inside and a quantity torque field, the homogeneity combustion mode control means 53 is chosen, and it is operated in homogeneity combustion mode. the time of this homogeneity combustion mode operation -- fuel oil consumption -- increasing -- like an inhalation-of-air line -- the inside of a cylinder -- injecting directly -- homogeneity -- engine power and the output torque are raised by forming gaseous mixture and carrying out homogeneity combustion.
[0029] Next, based on drawing 3 (a), each function of the homogeneity combustion mode control means 53 is explained. The homogeneity combustion mode control means 53 performs torque demand control of the air content priority method which changes demand illustration torque into target air volume, and sets up throttle opening. In consideration of changing illustration torque with the air-fuel ratio in ignition timing or a cylinder, a degree type amends demand illustration torque with ignition timing effectiveness (SA effectiveness) and air-fuel ratio effectiveness (A/F effectiveness) in that case.
[0030] Demand illustration torque after amendment = demand illustration torque/(ignition timing effectiveness x air-fuel ratio effectiveness)
Here, since it is set up on a map etc. according to the amount of ignition lags, and illustration torque becomes max when the amount of ignition lags is 0, ignition timing effectiveness is set as ignition timing effectiveness =1, when the amount of ignition lags is 0. Moreover, air-fuel ratio effectiveness is set up on a map etc. according to a target air-fuel ratio.
[0031] And based on the demand illustration torque and the engine speed Ne after amendment, the restoration air content in a target cylinder is computed on a map etc., and target throttle opening is computed using the target throttle opening operation model mentioned later based on this restoration air content in a target cylinder, engine-speed Ne and an EGR gas flow rate, a VVT tooth-lead-angle value, an evaporated gas purge flow rate, etc. And the control signal according to this target throttle opening is outputted to the motor 14 of an electronic throttle system, a throttle valve 15 is driven, and throttle opening is controlled.
[0032] Moreover, the homogeneity combustion mode control means 53 computes the restoration air content in a presumed cylinder using the restoration air content presumption model in a cylinder from the output (MAP Pm) of the output (throttle passage air content) of an air flow meter 13, engine-speed Ne, and the MAP sensor 18. And division process of this restoration air content in a presumed cylinder is carried out with a target air-fuel ratio, target fuel quantity is computed, the multiplication of various kinds of correction factors (a cooling water temperature correction factor, an air-fuel ratio feedback correction factor, study correction factor, etc.) is carried out to this target fuel quantity, final fuel oil consumption is calculated, the injection pulse of the pulse width according to this fuel oil consumption is outputted to a fuel injection valve 21 like the inhalation-of-air line of each gas column, and fuel injection is performed. thereby -- the time of homogeneity combustion mode operation -- like an inhalation-of-air line -- a fuel -- the inside of a cylinder -- injecting directly -- homogeneity -- gaseous mixture is formed and homogeneity combustion is carried out.

[0033] Furthermore, it computes a target VVT tooth-lead-angle value on a map etc. according to operational status, controls the hydraulic control valve 31 of the adjustable valve timing device 30 according to the calculation result, and controls a VVT tooth-lead-angle value to a target VVT tooth-lead-angle value while the homogeneity combustion mode control means 53 computes a target EGR gas flow rate on a map etc. according to an engine operation condition, drives EGR valve 40 according to the calculation result and controls an EGR gas flow rate to a target EGR gas flow rate. Furthermore, according to an engine operation condition, the ignition timing of each gas column is computed on a map etc., the high voltage is impressed to an ignition plug 25 at the ignition timing, and spark discharge is generated. The ignition timing effectiveness mentioned above from this ignition timing is computed.
[0034] Next, based on drawing 3 (b), each function of the stratification combustion mode control means 54 is explained. The stratification combustion mode control means 54 changes demand illustration torque into target fuel quantity, and performs torque demand control of the fuel quantity priority method which carries out the multiplication of this target fuel quantity and the target air-fuel ratio, and sets up throttle opening in quest of the restoration air content in a target cylinder. In that case, in consideration of changing illustration torque, division process of the demand illustration torque is carried out at air-fuel ratio effectiveness, and demand illustration torque is amended with the air-fuel ratio in a cylinder.
the demand illustration torque = demand illustration torque / air-fuel ratio effectiveness after amendment -- here, the calculation approach of air-fuel ratio effectiveness computes air-fuel ratio effectiveness on a map etc. as well as the case of the homogeneity combustion mode control means 53 according to a target air-fuel

ratio.
[0035] And based on the demand illustration torque and the engine speed Ne after amendment, target fuel quantity is computed on a map etc., the multiplication of various kinds of correction factors (a cooling water temperature correction factor, an air-fuel ratio feedback correction factor, study correction factor, etc.) is carried out to this target fuel quantity, final fuel oil consumption is calculated, the injection pulse of the pulse width according to this fuel oil consumption is outputted to a fuel injection valve 21 by the compression stroke of each gas column, and fuel injection is performed. thereby -- the time of stratification combustion mode operation -- a compression stroke -- a fuel -- the inside of a cylinder -- injecting directly -- stratification -- gaseous mixture is formed and stratification combustion is carried out.
[0036] Furthermore, the stratification combustion mode control means 54 computes ignition timing on a map etc. according to target fuel quantity and an engine speed Ne, impresses the high voltage to an ignition plug 25 at the ignition timing, and generates spark discharge.
[0037] Moreover, the stratification combustion mode control means 54 computes the restoration air content in a target cylinder by carrying out the multiplication of the target air-fuel ratio to target fuel quantity, computes target throttle opening based on this restoration air content in a target cylinder, engine-speed Ne, an EGR gas flow rate, a VVT tooth-lead-angle value, etc., outputs the control signal according to this target throttle opening to the motor 14 of an electronic throttle system, drives a throttle valve 15, and controls throttle opening. And while driving EGR valve 40 according to the target EGR gas flow rate set up based on target fuel quantity etc. and controlling an EGR gas flow rate to a target EGR gas flow rate, according to the target VVT tooth-lead-angle value set up based on target fuel quantity etc., the hydraulic control valve 31 of the adjustable valve timing device 30 is controlled, and a VVT tooth-lead-angle value is controlled to a target VVT tooth-lead-angle value.
[0038] Next, the configuration of the target throttle opening operation model which calculates target throttle opening based on the restoration air content in a target cylinder etc. at the time of homogeneity combustion mode operation is explained based on drawing 4 thru/or drawing 11 . The functional block diagram having shown the example of the function concerning [the functional block diagram, drawing 5 , and drawing 6 R> 6 which showed the outline of the function about throttle control here among the functions of the homogeneity combustion mode control means 53 which drawing 4 mentioned above] throttle control, and drawing 7 are the functional block diagrams having shown the function of the radical Motome label MAP operation means 62.
[0039] The restoration air content operation means 61 in a target cylinder is based on the demand illustration torque and the engine speed Ne which were calculated with the demand illustration torque operation means 51 of drawing 2 , and is the restoration air content Metg in a target cylinder by a map etc. It computes.
[0040] The radical Motome label MAP operation means 62 is the restoration air content Metg in a target cylinder calculated with the restoration air content operation means 61 in a target cylinder. It is based on an engine speed Ne and a VVT tooth-lead-angle value, and is radical Motome label MAP Pmbase. It computes as follows. beforehand -- a steady operation condition -- setting -- every tooth-lead-angle value of VVT -- an engine speed Ne, the restoration air content Metg in a target cylinder, and MAP Pm relation is measured and it is shown in drawing 7 -- as -- every tooth-lead-angle value of VVT -- an engine speed Ne and restoration air content Metg in a target cylinder from -- the map which computes radical Motome label MAP Pmbase is created, and it memorizes to ROM of ECU16. and radical Motome label MAP Pmbase the map corresponding to [in case it computes] the VVT tooth-lead-angle value at the time -- choosing -- an engine speed Ne and restoration air content Metg in a target cylinder from -- radical Motome label MAP Pmbase It computes.
[0041] Under the present circumstances, two maps nearest to [when not in agreement with the VVT tooth-lead-angle value of the map group the current VVT tooth-lead-angle value was remembered to be by ROM] a current VVT tooth-lead-angle value are chosen, and it is radical Motome label MAP Pmbase by linear interpolation. It computes. Two radical Motome label MAPs Pmbase computed from two maps in linear interpolation as shown in drawing 7 Radical Motome label MAP Pmbase approximate between in a straight line and corresponding to the VVT tooth-lead-angle value of the present [straight line / the] It computes.
[0042] Moreover, with this operation gestalt, the target idle rotational speed Netarget is used instead of the real engine speed Ne at the time of an idle, and it is radical Motome label MAP Pmbase. It computes. It is radical Motome label MAP Pmbase so that an engine speed Ne may be completed as the target idle rotational speed Netarget at the time of an idle, if it does in this way. Since it is set up, idle rotational stability can be improved. However, the real engine speed Ne is used for this invention at the time of an idle as well as the time of a non-idle, and it is radical Motome label MAP Pmbase. It cannot be overemphasized

that you may compute.
[0043] On the other hand, the amendment means 63 shown in drawing 4 is radical Motome label MAP Pmbase computed with the radical Motome label MAP operation means 62. It amends according to the predetermined parameter leading to [of a MAP] fluctuation, and is target MAP Pmtg. While functioning as a target inhalation-of-air pressure correction means to search for Restoration air content Metg in a target cylinder It functions also as a restoration air content amendment means in a target cylinder to amend according to the predetermined parameter leading to [of the restoration air content in a cylinder] fluctuation.
[0044] They are the EGR gas flow rate MEGR, the evaporated gas purge flow rate Mpurg, and an atmospheric pressure Po as a predetermined parameter which becomes the fluctuation factor of a MAP with this operation gestalt. It takes into consideration, as shown in drawing 5 , the EGR correction factor fEGR, the evaporated gas purge correction factor fpurg, and the atmospheric-pressure correction factor fPo are computed, and it is radical Motome label MAP Pmbase by these correction factors. It amends and is target MAP Pmtg. It asks.
[0045] under the present circumstances, EGR correction factor fEGR the case where it computes -- first -- the EGR gas flow rate presumption means 59 (refer to drawing 4) -- Opening EGRV, MAP Pm and atmospheric pressure Po of EGR valve 40, and OAT To etc. -- being based -- EGR gas flow rate MEGR presuming -- this EGR gas flow rate MEGR Restoration air content Metg in a target cylinder using -- a degree type -- EGR correction factor fEGR It computes.
fEGR =1+MEGR/Metg [0046] Moreover, when computing the evaporated gas purge correction factor fpurg, they are a rate of a purge, and MAP Pm first by the evaporated gas purge flow rate presumption means 60 (refer to drawing 4). It is based, the evaporated gas purge flow rate Mpurg is presumed, and they are this evaporated gas purge flow rate Mpurg and the restoration air content Metg in a target cylinder. It uses and the evaporated gas purge correction factor fpurg is computed by the degree type.
fpurg=1+Mpurg/Metg [0047] Next, the calculation approach of the atmospheric pressure correction factor fPo is explained using drawing 8 R> 8. The atmospheric pressure correction factor fPo is atmospheric pressure Po like [at the time of high-ground transit]. Also under the environment where it falls from a standard atmosphere Postd, the map measured under the conditions of lowlands transit (standard atmosphere Postd) is used, and it is criteria target MAP Pmbase. Restoration air content Metg in a target cylinder It is a correction factor for enabling it to calculate. The following relation is materialized in the steady operation condition at the time of lowlands transit.
[0048]
[Equation 1]

$$\mathrm{Mestd} = \mathrm{Mthstd} = \mathrm{C} \cdot \mathrm{A} \cdot \frac{\mathrm{Postd}}{\mathrm{R}\sqrt{\mathrm{To}}} \cdot \Phi\,(\mathrm{Pm/Postd}) \quad \text{----}\,(1)$$

Mestd ： 低地での筒内充填空気量
Mthstd ： 低地でのスロットル通過空気量
Postd ： 低地での大気圧(標準大気圧)
C ： 流量係数
A ： スロットル開口有効断面積
R ： 気体定数
To ： 外気温度

[0049] Here, phi (Pm/Postd) is computed on the map of a property as shown in drawing 8 etc. Moreover, the following relation is materialized in the steady operation condition at the time of high-ground transit.
[0050]
[Equation 2]

$$\mathrm{Mealt} = \mathrm{Mthalt} = C \cdot A \cdot \frac{\mathrm{Poalt}}{R\sqrt{\mathrm{To}}} \cdot \Phi(\mathrm{Pm}/\mathrm{Poalt}) \quad \text{----}(2)$$

Mealt ： 高地での筒内充填空気量

Mthalt ： 高地でのスロットル通過空気量

Poalt ： 高地での大気圧

Φ (Pm/Poalt) ： 吸気圧Pmと大気圧Poaltとの比で決まる圧力特性値

[0051] A degree type is drawn from the above (1) and (2) types.
[Equation 3]

$$\mathrm{Mealt} = \frac{\Phi(\mathrm{Pm}/\mathrm{Poalt})}{\Phi(\mathrm{Pm}/\mathrm{Postd})} \cdot \frac{\mathrm{Poalt}}{\mathrm{Postd}} \cdot \mathrm{Mestd} \quad \text{----}(3)$$

[0052] The above-mentioned (3) formula is same MAP Pm. The relation between the restoration air content Mestd in a cylinder of the receiving lowlands and the restoration air content Mealt in a cylinder of high ground is shown. MAP Pm same from this relation The relation between the restoration air content Metgstd in a target cylinder of the receiving lowlands and the restoration air content Metgalt in a target cylinder of high ground is called for as follows.
[0053]
[Equation 4]

$$\mathrm{Metgalt} = \frac{\Phi(\mathrm{Pm}/\mathrm{Poalt})}{\Phi(\mathrm{Pm}/\mathrm{Postd})} \cdot \frac{\mathrm{Poalt}}{\mathrm{Postd}} \cdot \mathrm{Metgstd}$$

$$= \mathrm{fPo} \cdot \mathrm{Metgstd} \quad \text{----}(4)$$

[0054] From the above-mentioned (4) formula, the atmospheric pressure correction factor fPo is computed by the degree type.
[Equation 5]

$$\mathrm{fPo} = \frac{\Phi(\mathrm{Pm}/\mathrm{Poalt})}{\Phi(\mathrm{Pm}/\mathrm{Postd})} \cdot \frac{\mathrm{Poalt}}{\mathrm{Postd}} \quad \text{----}(5)$$

[0055] Atmospheric pressure Po detected by the atmospheric pressure sensor 46 here If it assumes that it is a thing equivalent to the atmospheric pressure Poalt in high ground, a degree type will be called for from the above-mentioned (6) formula.
[0056]
[Equation 6]

$$\mathrm{fPo} = \frac{\Phi(\mathrm{Pm}/\mathrm{Po})}{\Phi(\mathrm{Pm}/\mathrm{Postd})} \cdot \frac{\mathrm{Po}}{\mathrm{Postd}} \quad \text{----}(6)$$

[0057] Since the atmospheric pressure (standard atmosphere) Postd in lowlands is constant value in the above-mentioned (6) formula, the variable of the above-mentioned (6) formula is MAP Pm. Atmospheric pressure Po It becomes and the value detected by the MAP sensor 18 and the atmospheric pressure sensor 46 should just be used for these.
[0058] It is radical Motome label MAP Pmbase about the EGR correction factor fEGR, the evaporated gas purge correction factor fpurg, and the atmospheric pressure correction factor fPo which were computed as mentioned above. Multiplication is carried out and it is target MAP Pmtg. It asks.
Pmtg =Pmbase xfEGR xfpurgxfPo .... (7)
[0059] In addition, it is related with the atmospheric pressure correction factor fPo, and is radical Motome label MAP Pmbase. Before computing, it is the restoration air content Metg in a target cylinder. The multiplication of the atmospheric pressure correction factor fPo is carried out, and it is the restoration air content Metg in a target cylinder. It amends with the atmospheric pressure correction factor fPo, and is the restoration air content Metg in a target cylinder after this amendment. It uses and is radical Motome label MAP Pmbase. You may make it compute.
[0060] the target MAP lower limit setting means 64 and the policy-objective MAP selection means 65 which are shown in drawing 4 on the other hand -- real MAP Pm Real MAP Pm which is a guard means

prevent falling extremely and detected by the MAP sensor 18 Target MAP Pmtg which computed the policy-objective MAP selection means 65 by the above-mentioned (7) formula when higher than the predetermined target MAP lower limit Pmlimit Final target MAP Pmtg ****** -- it chooses.

[0061] on the other hand, real MAP Pm detected by the MAP sensor 18 the target MAP lower limit Pmlimit which set up the policy objective MAP selection means 65 with the target MAP lower limit setting means 64 when it became below the predetermined target MAP lower limit Pmlimit -- final target MAP Pmtg ****** -- it chooses. This target MAP lower limit Pmlimit is MAP Pm. It is set up so that sucking and the lack of an air content (aggravation of a combustion condition) of the engine oil in the cylinder caused by extreme fall can be prevented.

[0062] Moreover, the restoration air content lower limit setting means 65 in a target cylinder and the restoration air content selection means 67 in a policy objective cylinder Real MAP Pm which is a guard means to prevent that the restoration air content in a cylinder decreases extremely, and was detected by the MAP sensor 18 When it becomes below the predetermined target MAP lower limit Pmlimit The restoration air content selection means 67 in a policy objective cylinder It is the final restoration air content Metg in a target cylinder about the value which amended the restoration air content lower limit Metglimit in a target cylinder set up corresponding to the target MAP lower limit Pmlimit with the restoration air content lower limit setting means 65 in a target cylinder by the evaporated gas purge flow rate Mpurg. It chooses by carrying out (refer to drawing 5).

Final Metg =Metglimit-Mpurg [0063] on the other hand, real MAP Pm detected by the MAP sensor 18 Restoration air content Metg in a target cylinder which computed the restoration air content selection means 67 in a policy objective cylinder with the restoration air content operation means 61 in a target cylinder when higher than the predetermined target MAP lower limit Pmlimit the value amended by the evaporated gas purge flow rate Mpurg -- final restoration air content Metg in a target cylinder ****** -- it chooses (refer to drawing 5).

Final Metg =Metg-Mpurg [0064] On the other hand, the target throttle opening operation model with phase lead compensation mentioned later is used for the target throttle opening operation means 68 shown in drawing 4 , and it is target MAP Pmtg. Restoration air content Metg in a target cylinder It is based and is the target throttle opening Thrcom. It calculates and is this target throttle opening Thrcom. The embraced control signal is outputted to a throttle actuator (motor 14), a throttle valve 15 is driven, and it is the target throttle opening Thrcom about throttle opening. It controls.

[0065] The target throttle opening operation model with phase lead compensation used with this operation gestalt is drawn from an inhalation-of-air system model (a throttle model and inlet-manifold model) as shown in drawing 9 as follows.

[0066] An inlet-manifold model models the behavior of the inhalation air which flows the inhalation-of-air path (henceforth a "throttle down-stream inhalation-of-air path") from a throttle valve 15 to the inlet of an engine 11, and is drawn from the equation of state of the law of conservation of mass and a gas as follows. If the law of conservation of mass is applied to the flow of the inhalation air of a throttle down-stream inhalation-of-air path, the relation expressed with the following (8) types will be obtained.

[0067]

d/dt-Mim=Mth-Me .... (8)

Here, d/dt-Mim is the variation of the air mass in a throttle down-stream inhalation-of-air path, and Mth is a throttle passage air content and Me. It is a restoration air content in a cylinder. In addition, d/dt-Mim, and Mth and Me Each is a value per unit time amount (or sampling period).

[0068] Moreover, if a gaseous equation of state is applied to a throttle down-stream inhalation-of-air path, the relation expressed to the following (9) equations will be obtained.

Me =eta- (Ne/60) / 2, and Vc - (Mim/Vim) .... (9)

eta: Volumetric efficiency Ne : Engine speed [rpm]

Vc : volume of a cylinder capacity Vim:throttle down-stream inhalation-of-air path [0069] The following (10) types are drawn from the above (8) and (9) types.

D/dt-Mim=Mth-eta - (Ne/60) / 2, and Vc - (Mim/Vim)

= Mth-Mim/tau im .... (10)

Here, tauim is the model time constant of an inlet-manifold model, and is expressed with the following (11) types.

tauim=120andVim/(eta-Ne and Vc) .... (11)

A degree type will be obtained if the Laplace transform of the aforementioned (10) formula is carried out.

[0070]

[Equation 7]

$$sMim = Mth - \frac{1}{\tau im} \cdot Mim$$

$$\therefore\ Mim = \frac{1}{s+1/\tau im} \cdot Mth$$

$$= \frac{\tau im}{1+\tau im \cdot s} \cdot Mth \qquad \text{----(12)}$$

[0071] The inlet-manifold model type expressed with the following (13) types is drawn from the above (9), (11), and (12) types.
[0072]
[Equation 8]

$$Me = \frac{1}{\tau im} \cdot Mim = \frac{1}{\tau im} \cdot \frac{\tau im}{1+\tau im \cdot s} \cdot Mth$$

$$= \frac{1}{1+\tau im \cdot s} \cdot Mth \qquad \text{----(13)}$$

[0073] The inlet-manifold model expressed with the above-mentioned (13) formula is the throttle passage air content Mth to the restoration air content Me in a cylinder. It is the model to calculate. therefore -- if the reverse model of this inlet-manifold model is used -- restoration air content Me in a cylinder from -- the throttle passage air content Mth can be calculated.
[0074] The reverse model of this inlet-manifold model is drawn from the above-mentioned (13) formula as follows.
Mth=(1+tauim-s) Me =Me+tauim-s-Me .... (14)
It sets at an upper ceremony and is tauim-s-Me. If the derivative element by the inverse transformation of a first order lag element is approximated by phase lead compensation in order to prevent emission, the reverse inlet-manifold model (reverse model of an inlet-manifold model) expressed with the following (15) types will be drawn.
[0075]
[Equation 9]

$$Mth \fallingdotseq Me + \tau im \cdot \underbrace{\frac{\alpha T \cdot s}{1+\alpha T \cdot s}}_{\text{位相進み補償}} \cdot Me \qquad \text{----(15)}$$

α : 時定数($\alpha>1$)

T : サンプリング周期

[0076] therefore, restoration air content Metg in a target cylinder from -- the reverse inlet-manifold model which calculates the target throttle passage air content Mthtg is expressed with a degree type.
[0077]
[Equation 10]

$$Mthtg \fallingdotseq Metg + \tau im \cdot \frac{\alpha T \cdot s}{1+\alpha T \cdot s} \cdot Metg \qquad \text{----(16)}$$

[0078] On the other hand, the throttle model is constituted as shown in drawing 10 . This throttle model is expressed with a degree type.
[0079]
[Equation 11]

$$\begin{aligned} Mth &= C \cdot A \cdot \frac{Po}{R\sqrt{To}} \cdot \Phi o \\ &= f(Thr) \cdot \frac{Po}{\sqrt{To}} \cdot \Phi o \qquad \text{----}(17) \end{aligned}$$

C ： 流量係数

A ： スロットル開口有効断面積

R ： 気体定数

To ： 外気温度

Po ： 大気圧

Φo ： 圧力特性値

f(Thr) ： スロットル通過空気量特性値

$$f(Thr) = C \cdot A \cdot \frac{1}{R}$$

[0080] Here, the throttle passage air content characteristic value f (Thr) is calculated on a map etc. according to the throttle opening Thr. This throttle passage air flow-characteristics value f (Thr) is set up so that the throttle opening Thr becomes large, and the throttle passage air flow rate Mth may become large. Moreover, pressure characteristic value phio MAP Pm Atmospheric pressure Po Although calculated on a map etc. according to a ratio, theoretically, it can calculate by the degree type.

[0081]

[Equation 12]

$$\frac{Pm}{Po} > \left(\frac{2}{\kappa+1}\right)^{\kappa/(\kappa-1)} \text{の時}$$

$$\Phi o = \frac{2\kappa}{\kappa-1}\sqrt{\left(\frac{Pm}{Po}\right)^{2/\kappa} - \left(\frac{Pm}{Po}\right)^{(\kappa+1)/\kappa}}$$

$$\frac{Pm}{Po} \leqq \left(\frac{2}{\kappa+1}\right)^{\kappa/(\kappa-1)} \text{の時}$$

$$\Phi o = \frac{2\kappa}{\kappa-1}\sqrt{\left(\frac{2}{\kappa+1}\right)^{2/(\kappa-1)} - \left(\frac{2}{\kappa+1}\right)^{(\kappa+1)/(\kappa-1)}}$$

κ ： 比熱比

[0082] The throttle model expressed with the aforementioned (17) formula is a model which calculates the throttle passage air content Mth from the throttle opening Thr. Therefore, if the reverse model (reverse throttle model) of this throttle model is used, the throttle opening Thr can be calculated from the throttle passage air content Mth. This reverse throttle model is drawn from the aforementioned (17) formula as follows.

[0083]

[Equation 13]

$$f(Thr) = \frac{\sqrt{To}}{Po} \cdot \frac{1}{\Phi o} \cdot Mth \qquad \text{----}(18)$$

$$\therefore\ Thr = f^{-1}\left(\frac{\sqrt{To}}{Po} \cdot \frac{1}{\Phi o} \cdot Mth\right) \qquad \text{----}(19)$$

[0084] Therefore, the target throttle passage air content Mthtg to target throttle opening Thrcom The reverse throttle model to calculate is expressed with a degree type.

[0085]
[Equation 14]

$$\mathrm{Thrcom} = f^{-1}\left(\frac{\sqrt{To}}{Po} \cdot \frac{1}{\Phi o} \cdot \mathrm{Mthtg}\right) \quad \text{----}(20)$$

[0086] the restoration air content Metg in a target cylinder which mentioned above from -- the target throttle passage air content Mthtg to (16) types of a reverse inlet-manifold model which calculate the target throttle passage air content Mthtg, and target throttle opening Thrcom combining (20) types of the reverse throttle model to calculate -- restoration air content Metg in a target cylinder from -- target throttle opening Thrcom The target throttle opening operation model to calculate is drawn. The configuration of this target throttle opening operation model (reverse model of an inhalation-of-air system model) is shown to drawing 11 by the block diagram.
[0087] The target throttle opening operation model explained above is used, and it is the target throttle opening Thrcom. Processing to calculate is performed by the throttle control program shown in drawing 12 and drawing 13 . This program is performed by ECU16 for every predetermined time and every predetermined crank angle. If this program is started, first, it is based on demand illustration torque and an engine speed Ne at step 101, and is the restoration air content Metg in a target cylinder by a map etc. It computes. Under the present circumstances, at the time of an idle, in order to raise idle rotational stability, the target idle rotational speed Netarget is used instead of the real engine speed Ne, and it is the restoration air content Metg in a target cylinder. You may make it compute.
[0088] Then, it progresses to step 102 and is the restoration air content Metg in a target cylinder. It is based on an engine speed Ne and a VVT tooth-lead-angle value, and is radical Motome label MAP Pmbase. It computes. Under the present circumstances, at the time of an idle, in order to raise idle rotational stability, the target idle rotational speed Netarget is used instead of the real engine speed Ne, and it is radical Motome label MAP Pmbase. You may make it compute.
[0089] then, the step 103 -- progressing -- Opening EGRV and MAP Pm of EGR valve 40, atmospheric pressure Po, and OAT To etc. -- being based -- EGR gas flow rate MEGR presuming -- this EGR gas flow rate MEGR Restoration air content Metg in a target cylinder using -- a degree type -- EGR correction factor fEGR It computes.
fEGR =1+MEGR/Metg [0090] And they are a rate of a purge, and MAP Pm at the following step 104. It is based, the evaporated gas purge flow rate Mpurg is presumed, and they are this evaporated gas purge flow rate Mpurg and the restoration air content Metg in a target cylinder. It uses and the evaporated gas purge correction factor fpurg is computed by the degree type.
Atmospheric pressure Po detected by the atmospheric pressure sensor 46 at fpurg=1+Mpurg/Metg and also step 105 It uses and the atmospheric pressure correction factor fPo is computed by (6) types mentioned above.
[0091] Then, it progresses to step 106 and is radical Motome label MAP Pmbase about the EGR correction factor fEGR, the evaporated gas purge correction factor fpurg, and the atmospheric pressure correction factor fPo. Multiplication is carried out and it is target MAP Pmtg. It asks.
Pmtg =Pmbase xfEGR xfpurgxfPo [0092] And it judges whether MAP Pm detected by the MAP sensor 18 is below the predetermined target MAP lower limit Pmlimit at the following step 107. This target MAP lower limit Pmlimit is MAP Pm. It is set up so that sucking and the lack of an air content (aggravation of a combustion condition) of the engine oil in the cylinder caused by extreme fall can be prevented. that this target MAP lower limit Pmlimit considers as the fixed value beforehand set up in an experiment, simulation, etc. **** -- or restoration air content Metg in a target cylinder etc. -- you may make it set up on a map etc. according to a service condition
[0093] It is real MAP Pm at the above-mentioned step step 107. If judged below with the target MAP lower limit Pmlimit, it will progress to step 108 and will be final target MAP Pmtg about the target MAP lower limit Pmlimit. It sets up by carrying out.
Pmtg =Pmlimit [0094] Then, it progresses to step 109, the restoration air content lower limit Metglimit in a target cylinder corresponding to the target MAP lower limit Pmlimit is computed, and it is the restoration air content Metg in a target cylinder at the following step 110 about this restoration air content lower limit Metglimit in a target cylinder. It sets up by carrying out.
Metg =Metglimit [0095] On the other hand, it is real MAP Pm at the above-mentioned step 107. It is the restoration air content Metg in a target cylinder computed at step 101,106 mentioned above when judged

with it being higher than the predetermined target MAP lower limit Pmlimit. Target MAP Pmtg It uses as it is.
[0096] It is the restoration air content Metg in a target cylinder as mentioned above. Target MAP Pmtg After determining, it progresses to step 111 and is the restoration air content Metg in a target cylinder by the evaporated gas purge flow rate Mpurg. It amends and is the final restoration air content Metg in a target cylinder. It asks.
Metg =Metg-Mpurg [0097] Then, the reverse inlet-manifold model progressed and mentioned above is used for step 112, and it is the restoration air content Metg in a target cylinder. The target throttle passage air content Mthtg is computed by carrying out phase lead compensation.
[0098] And they are the target throttle passage air content Mthtg, atmospheric pressure Po, OAT To, and pressure characteristic value phio about the throttle passage air flow-characteristics value f of the reverse throttle model mentioned above at the following step 113 (Thr). It uses and computes by the degree type.
[0099]
[Equation 15]

$$f(\mathrm{Thr}) = \frac{\sqrt{\mathrm{To}}}{\mathrm{Po}} \cdot \frac{1}{\Phi\mathrm{o}} \cdot \mathrm{Mthtg}$$

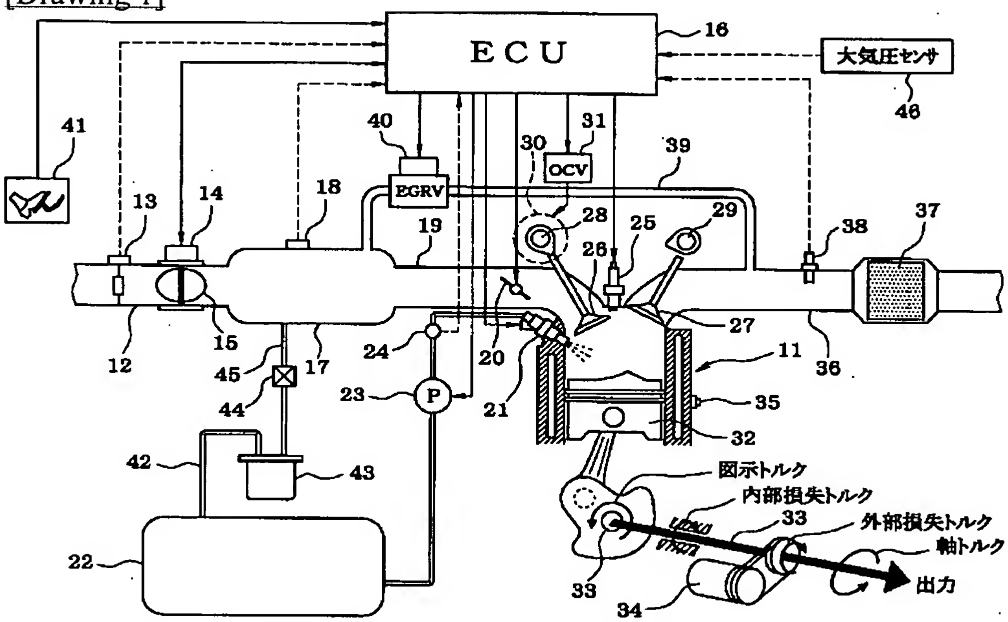
[0100] Under the present circumstances, pressure characteristic value phio Pmtg/Po What is necessary is just to compute on the map made into a parameter. Then, it progresses to step 114, it responds to the throttle passage air flow-characteristics value f (Thr), and is the target throttle opening Thrcom from a map etc. It computes. Then, it progresses to step 115 and is this target throttle opening Thrcom. The embraced control signal is outputted to a motor 14, and it is the target throttle opening Thrcom about throttle opening. It controls to make it in agreement.
[0101] With this operation gestalt explained above, since target throttle opening is calculated based on a target MAP and the restoration air content in a target cylinder, as compared with the case where target throttle opening is calculated, the control precision of the restoration air content in a cylinder can be improved only from the restoration air content in a target cylinder like before. And the radical Motome label MAP calculated based on the restoration air content in a target cylinder, and the engine speed Since it amends according to the predetermined parameter (for example, an EGR gas flow rate, an evaporated gas purge flow rate, atmospheric pressure) leading to [of a MAP] fluctuation and asked for the target MAP The target throttle opening which eliminated effect with the parameter concerned can be calculated, and the precise throttle control which fulfills the restoration air content in a target cylinder is attained also under the service condition to which a MAP is changed with the parameter concerned.
[0102] Furthermore, with this operation gestalt, the restoration air content in a target cylinder calculated based on demand illustration torque etc. is amended according to the predetermined parameter (for example, evaporated gas purge flow rate) leading to [of the restoration air content in a cylinder] fluctuation. Since target throttle opening was calculated based on the restoration air content in a target cylinder and target MAP after amendment, the effect of a fluctuation factor can be eliminated about the restoration air content in a target cylinder as well as a target MAP.
[0103] Moreover, with this operation gestalt, when a MAP (intake manifold pressure) becomes below a predetermined target MAP lower limit Since a target MAP is set as a target MAP lower limit and the restoration air content in a target cylinder was set as the restoration air content lower limit in a target cylinder corresponding to a target MAP lower limit for example, also under a service condition to which demand illustration torque becomes small at the time of high engine speeds like at the time of downward slope transit and moderation of high-speed transit The extreme fall of a MAP is avoidable, the engine oil in a cylinder can be sucked up in an inlet manifold, or the restoration air content in a cylinder is insufficient, and fault, like a combustion condition becomes unstable can be prevented beforehand.
[0104] Furthermore, with this operation gestalt, since change (change of a throttle passage air content) of throttle opening was made to carry out phase lead compensation of the restoration air content in a target cylinder by the delay in consideration of delay until it appears as change of the actual restoration air content in a cylinder, it can eliminate the effect of the lag unit of an inhalation-of-air system, and can improve the control precision of the restoration air content in a cylinder.
[0105] In addition, with this operation gestalt, although it has all of an adjustable valve timing device, an EGR system, and an EBAPO purge system, with the application of this invention, it can carry out also in an engine without two of one or systems of these.
[0106] In addition, it cannot be overemphasized that it changes variously that this invention is not limited to

the injection type engine in a cylinder, but is applied also to the suction-port injection type engine carrying an electronic throttle system, and can be carried out etc., and can carry out.

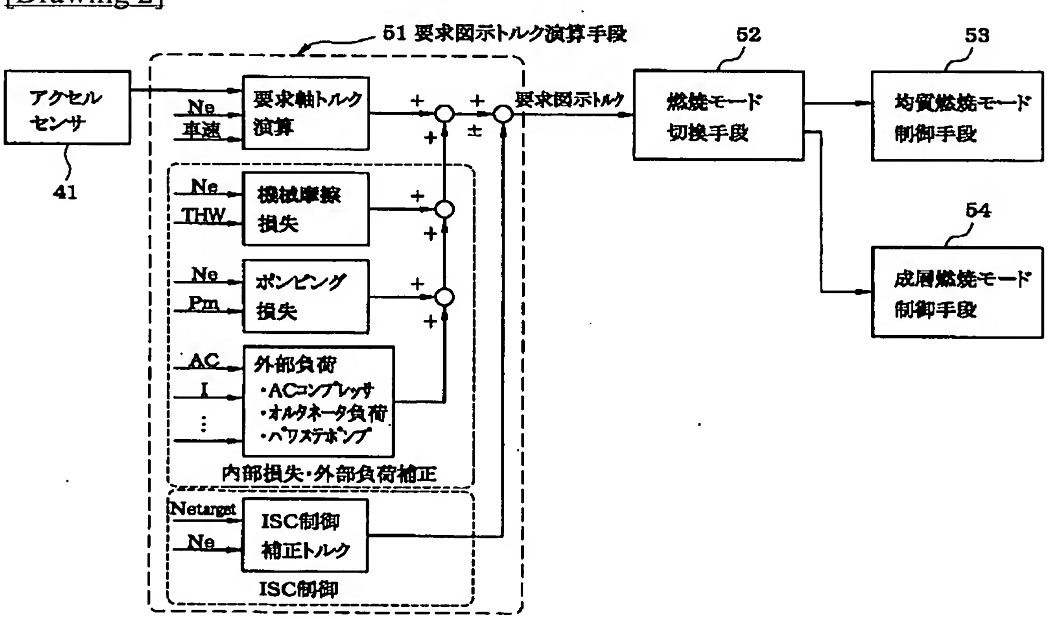
[Translation done.]

DRAWINGS

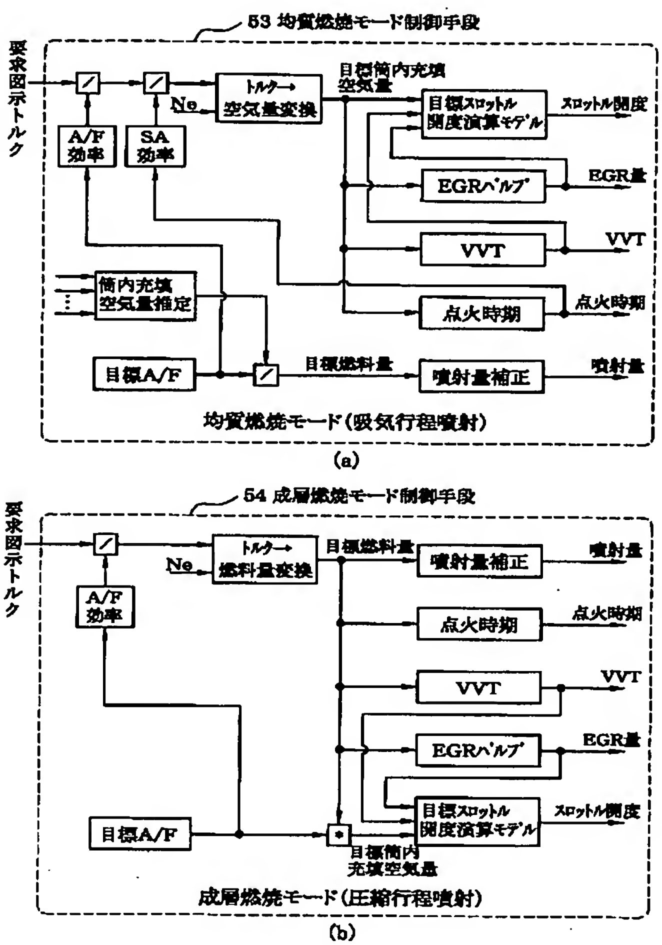
[Drawing 1]



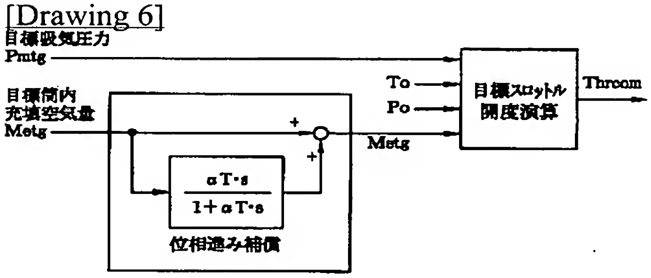
[Drawing 2]



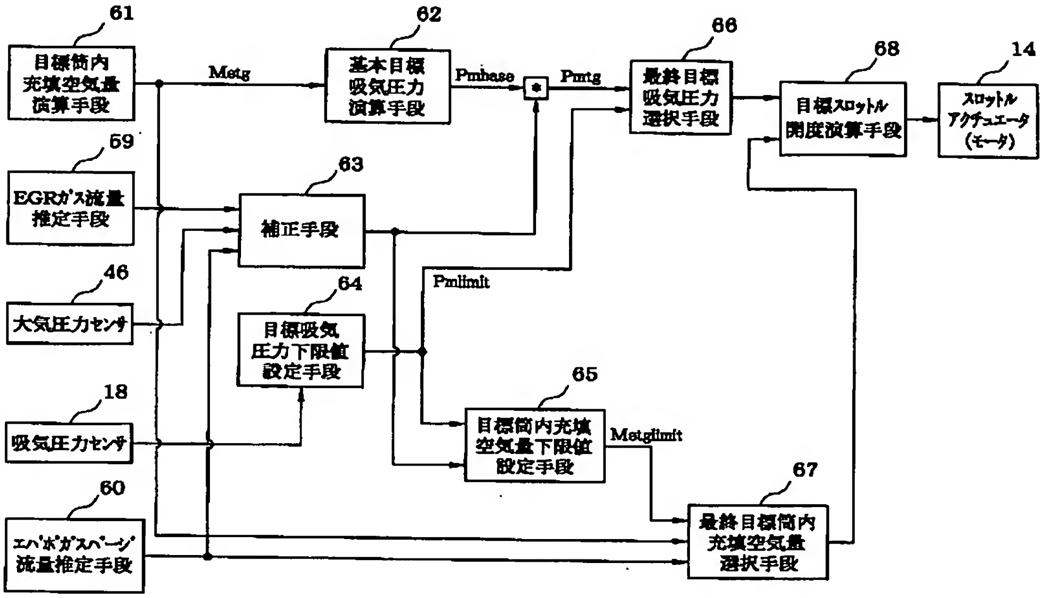
[Drawing 3]



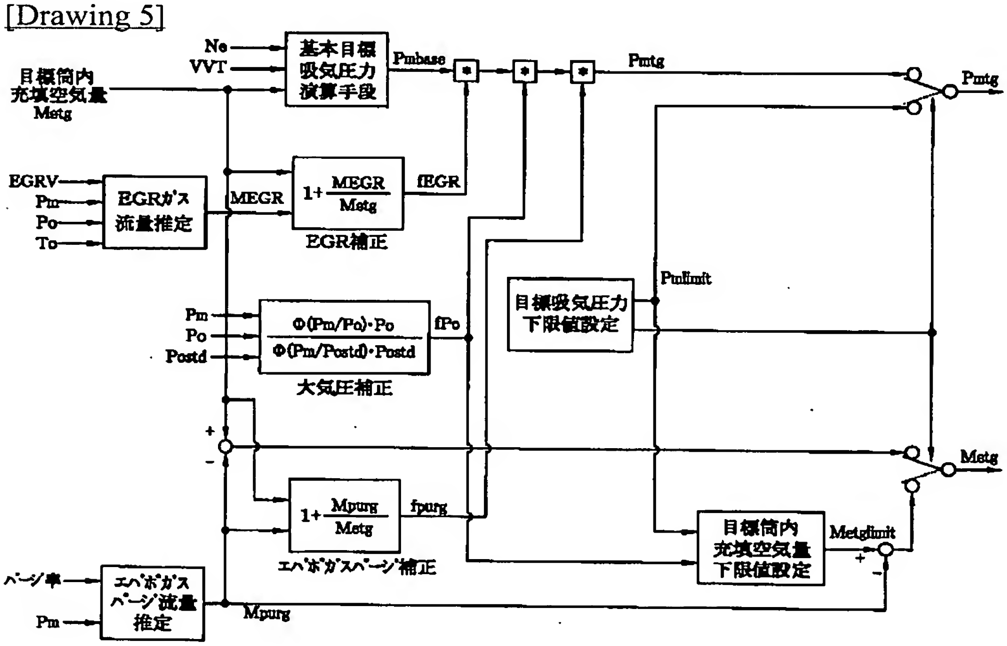
[Drawing 6]



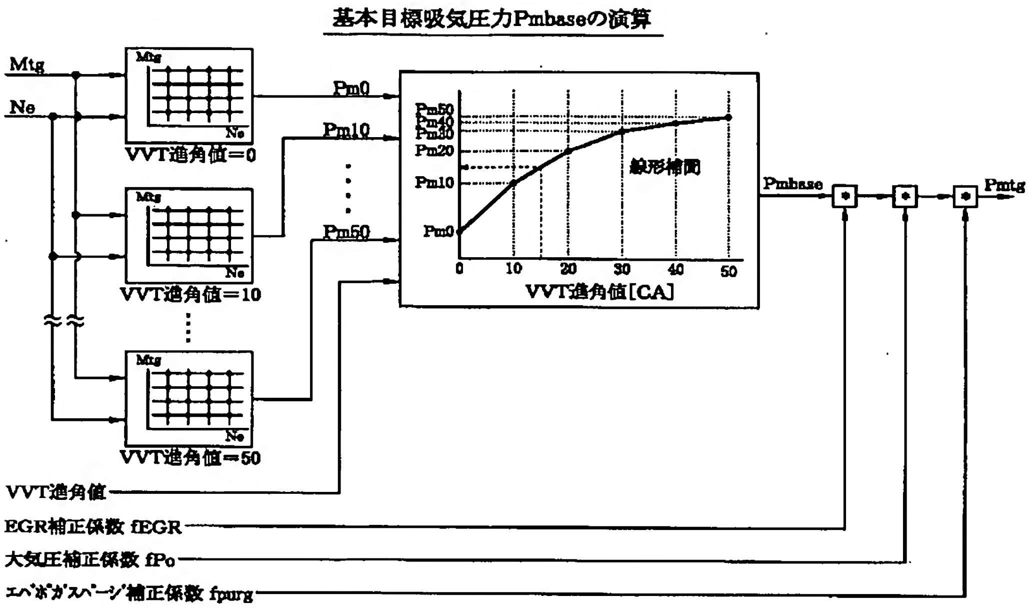
[Drawing 4]



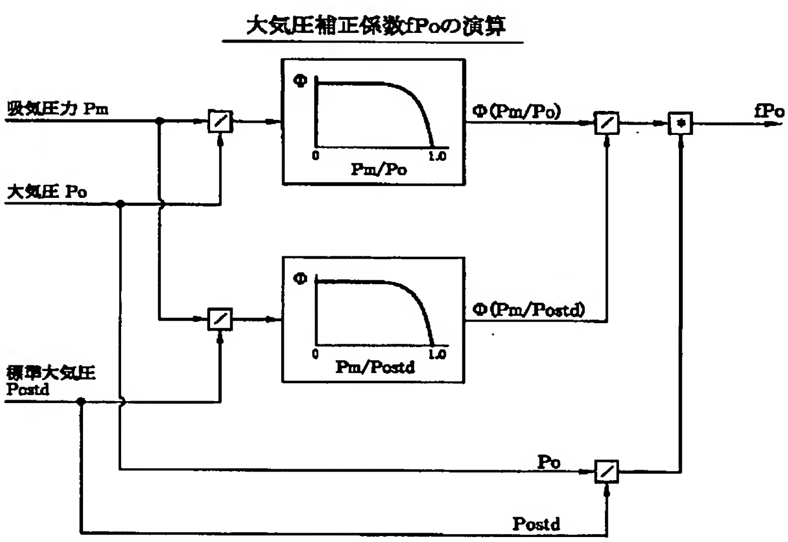
[Drawing 5]



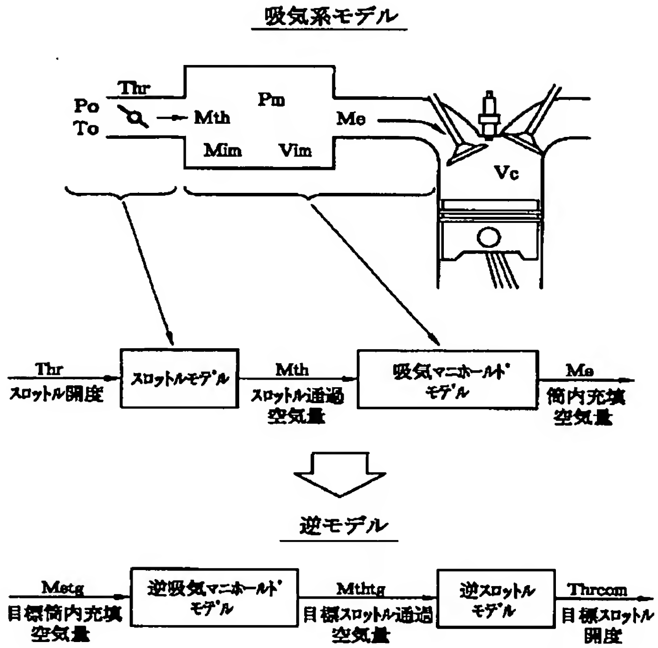
[Drawing 7]



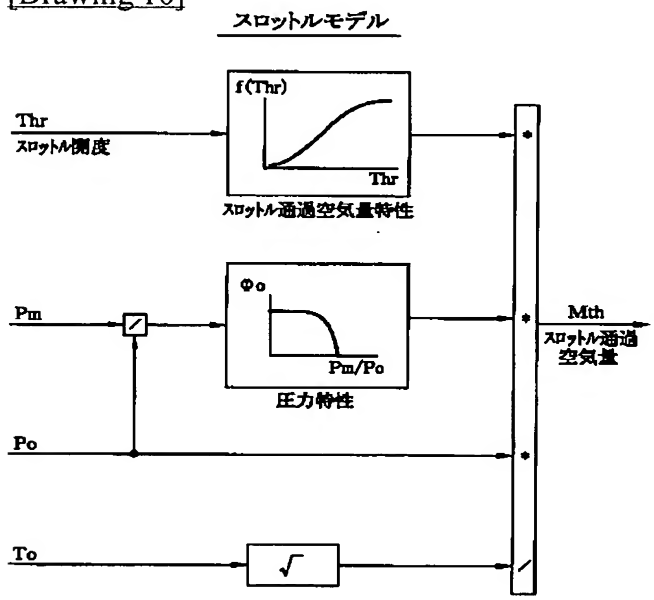
[Drawing 8]



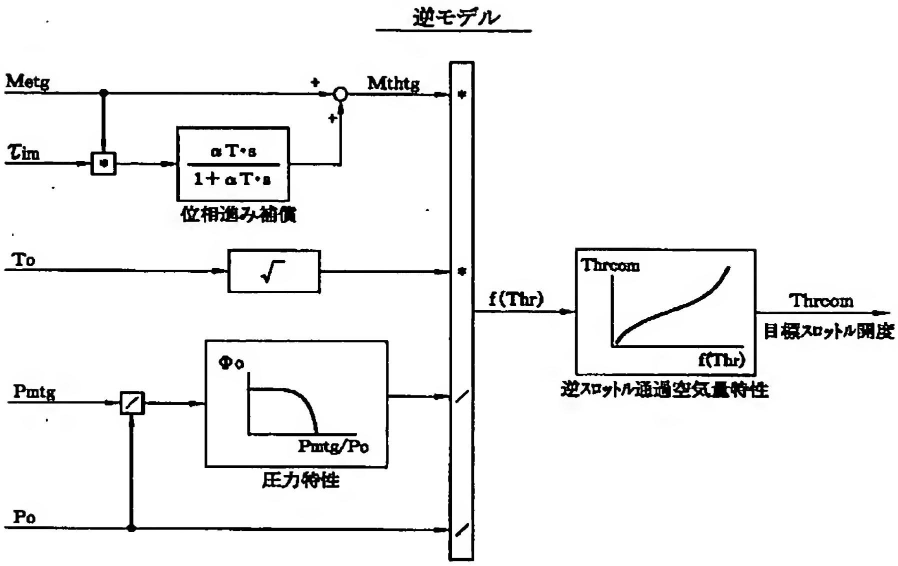
[Drawing 9]



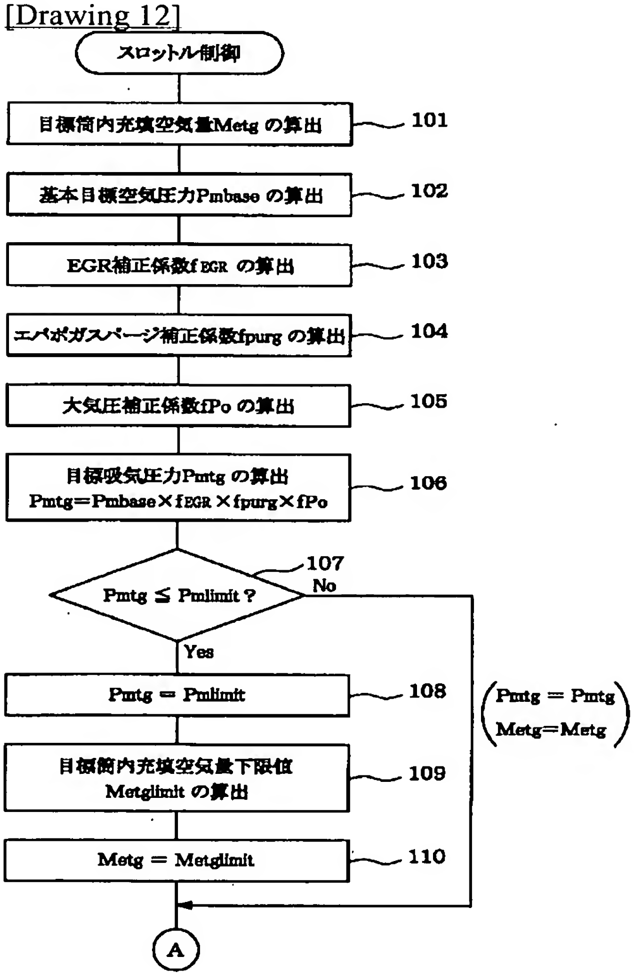
[Drawing 10]



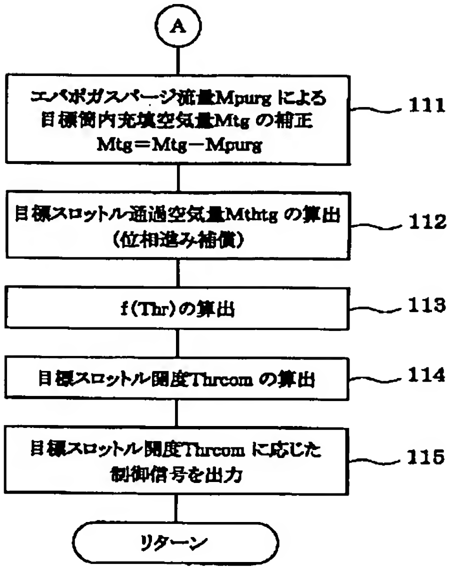
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]